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Potential Analysis of Compressed Natural Gas (CNG) Vehicle and Its Use in Bangladesh

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Abstract

The use of CNG in Bangladesh is increasing day by day due to the environmental benefits as well as economic benefits. In the last decade, the importance of environment conservation has assumed great significance. Even in Bangladesh the last couple of years have witnessed a greater devotion and awakening towards the protection of the environment. Pollution due to petroleum products used in transportation is an ever-increasing problem for Bangladesh like other country. So alternative solution of energy source is trying to use, thus pressure on Compressed Natural Gas (CNG) has been increased. Though, the environmental problem is solved but the stock of gas is simultaneously decreasing. The purpose of the study is to make coordination between the environmental awareness concept and the use of the natural gas should be connected in such a manner to achieve the success of Bangladesh.

INTRODUCTION

Compressed Natural Gas (CNG) is an important vehicular fuel in Bangladesh because the country has a significant natural gas resources and the natural gas transmission and distribution network is well developed. Technical experts have suggested the use of Compressed Natural Gas (CNG) as an alternative fuel for automobiles because of it is less hazardous, environment friendly and is quite cost effective. CNG consists mostly of methane and is drawn from gas wells or in conjunction with crude oil production. CNG vehicles store natural gas in high-pressure fuel cylinders at 3,000 to 3,600 pounds per square inch. An odorant is normally added to CNG for safety reasons. The emission levels of two pollutants- lead and SO_2 are directly related to fuel composition. Eliminating lead from gasoline, which is not naturally found in gasoline but added to enhance octane will eliminate lead emissions associated with fuel combustion from all gasoline-powered vehicles. CNG (130 octane) is energy efficient fuel than petrol (93 octane). This higher octane rating allows higher compression ratios and improved thermal efficiency, thus reducing carbon dioxide emissions. Compared to petrol or diesel, CNG vehicles emit 40% less of nitrous oxide, 90% less of hydrocarbons, 80% less of carbon monoxide and 25% less of carbon dioxide. Moreover, noise level of CNG engine is much lower than that of diesel. But scientific studies have established that CNG takes up more space for each gasoline gallon equivalent (GGE) compared to other gasoline power vehicle. After having this drawback, CNG has a high growth in Bangladesh due to low fuel cost. A significant change in transport section has been pointed after introducing CNG at Bangladesh market. So, the high consumption of CNG makes the government, the policy makers, the investors and the related personnel of this sector are concerned and willing to overcome the high consumption rate of CNG.

LITERATURE REVIEW

There have been conducted some research [1] - [7] on CNG use in Bangladesh. The suitability of CNG as vehicular fuel has been studied on 2010 [1]. The environmental effect, economic benefits and the ways of commercialization of CNG and the growth pattern of CNG filling stations, CNG conversion workshops in Bangladesh has also been studied there. There are also studies [2] about cleaner fuels and substantial improvements in air quality as well use of CNG as an alternative fuel for air pollution control [3].

Government has given permission to the private sector entrepreneur to install CNG refueling station and to establish of CNG conversion workshop and Government has also provided land to some private entrepreneurs for establishment of CNG conversion workshop and CNG refueling station [4]. The use of CNG for vehicle of Bangladesh has been studied for last decades [5]. The environmental effect, the export opportunity and reserve of natural gas has also been studied [6]. The government of Bangladesh is taking few steps for coordination between the environmental awareness concept and the use of the CNG in vehicle. The purpose of the study is to find out present scenario of Bangladesh of using CNG as vehicular fuel and find out some proper ways for the environmental and economic benefits of the country. And the commercialization of CNG as well as the growth pattern of CNG conversion workshops in Bangladesh.

CNG IN BANGLADESH

CNG was first introduced in Bangladesh in 1982 through World Bank pilot project. Rupantarita Prakritik Gas Company Limited (RPGCL) was established in 1987 which is responsible for popularizing CNG in transport sector by the establishment of a CNG-based transportation infrastructure in Bangladesh and widening its commercial operation. After that in 1999, four private companies start their journey in CNG sector [7].

Energy resources information is critical in determining the fuel mix of the future. Table-1 shows resource information for Bangladesh. As can be seen, Bangladesh is not very well endowed with energy resources. Natural gas reserves are only 16 Trillion cubic feet (Tcf), but there exist a resource potential of 32-42 Tcf. The country's coal resources are under development. By 2010, annual production is projected to be able to supply coal for 600 MW of power [8].

Table-1: Significant Energy Resources of Bangladesh

Resource	Amount	Status
Natural Gas	20.63 Tcf	Reserves
	32-37 Tcf	Resources (mean)
Coal	600 Mt	Reserves

Venture with RPGCL to set up 51 stations wherever piped gas is available in early 2000. But the current scenario of usages of CNG in Bangladesh can be described as Table-2 [9].

Table-2: Present scenario of CNG conversion and usages

Fiscal Year	No. of CNG filling station	No. of workshop	No. of converted vehicle	No. of CNG run vehicle
2008-09	213	17	24516	26141
2007- 08	85	13	22718	24042
2006-07	42	28	25974	38454
2005-06	23	31	23374	38353
2004-05	41	22	10135	10525
2003-04	41	19	8575	9308
2002-03	6	3	188	10571
2001-02	3	3	4516	4516
2000-01	2	1	839	839
1983-00	7	1	1379	1379

STRATEGIC STEPS OF GOVERNMENT OF BANGLADESH IN CNG SECTOR

A. Development of management and technical capacity

The organizational structure of RPGCL was revised to reflect changes in the CNG industry. An in-depth training program is carried out by RPGCL in the development of an alternative fuels program. The training covered CNG fuel technologies and applications, regulatory frameworks, standards and code regimes, safety protocols for conversion and refueling systems, emission standards and related enforcement needs.

B. *Support through government policies and regulatory changes*

The changes include the banning of two-stroke auto-rickshaws as of January 2003 in favor of four-stroke CNG vehicles and the conversion of all government official vehicles to CNG.

C. To promote into the private entrepreneurs

Government offers an attractive package for entrepreneurs to promote CNG by free of charge registration and enlisting; assistance and cooperation to obtain bank loans; necessary information; training for manpower engaged in running the station; assistance in site selection and taking lease of government land; quick gas, water and electricity connections at CNG stations.

EXPORT OF NATURAL GAS

At the rate of production, Bangladesh has enough recoverable gas to meet consumption for between 38-40 years. The potential investors are particularly concerned that Petrobangla's financial resources are not sufficient to absorb any substantial increase in gas purchases and unless they have a hard currency market for increased production, it is very hard to justify investment on which returns are uncertain. There has been constant pressure on the Bangladesh Government by those foreign oil companies that are involved in gas exploration, to allow gas to be exported and more specifically, exported to India. The current position of the government is that exports would only be considered if Bangladesh had proven reserves to meet their consumption needs for a minimum of 50 years.

CHALLENGES FOR IMPLEMENTATION AND EXPANSION

A. *Lack of skill technician and training program*

There are difficulties in retaining trained staff. As newly joined staffs are often used in CNG conversion workshops and related to others, so development is quite hard. Due to the lack of trained personnel in the private sector they are failed capable of carrying out the full range of conversions. A new tendency of CNG technician is seen to change their occupation.

B. *Lack of policy and regulatory framework*

A long-term policy including one that promotes a user-friendly, customer-oriented and safety-based conversion protocol is required. Government doesn't have any particular data on how many days CNG can be used as an alternative fuel. Lack of knowledge in both public and private sectors on how an alternative fuels program can be successfully implemented and sustained in future. At present, Petrobangla and its subsidiaries, like any other government organization, have become much less effective. Difficulty in moving to a results-oriented organizational structure based on RPGCL's priorities. Government support is required to provide continuing education and training to CNG industry stakeholders so that they can keep abreast of new technologies and best practices.

C. *Lack of CNG conversion items*

Quality kits or cylinders compatible with the different types of vehicles used in Bangladesh are not easy to find. Regarding safety standards, a consistent policy is not available for the CNG conversion items. The addition of CNG fuelling equipment to the existing petrol filling stations is problematic, because a large part of them are not having disposition over enough ground space to accommodate a safe CNG compressor, dispenser and high pressure gas storage installation. Recently, Government of Bangladesh has imposed VAT on the CNG conversion items as a result the price of the CNG conversion increases.

D. *Unavailability of gas all over the country*

According to Petrobangla's recent research shown that Bangladesh has a gas of 32-37 Tcf where recoverable is 20.63 Tcf, after all remaining reserve will be 13.53 Tcf. Current daily average gas demand of 1,890 million cubic feet per day (MMCFD) is expected to increase to 3,559 MMCFD by 2017. Recent investments by national oil companies and IOCs will increase gas production by 49%, to 3,055 MMCFD, by 2017. The government has finalized contracts to increase in supply by 74% and bringing it to 3,555 MMCFD by 2017. Out of the total production of around 87 MMSCMD (million standard cubic meters per day), after internal consumption, extraction of LPG and unavoidable flaring, around 74 MMSCMD is available for sale to various consumers. [10] - [11]. This alarming statistics is a clear indication of a crucial time in near future.

E. *Unavailability of gas distribution*

Gas distribution pipelines are not available to the whole country. Only 30-35 percent area is covered by the gas distribution network. It takes hours for refueling of CNG vehicles because of long queues due to in adequate number of filling stations. Gas stations observe a reduced gas pressure at peak hours.

F. *Focus on Electricity Generation:*

Government right now focuses on electricity generation with this existing gas in Bangladesh. Recently the Government of Bangladesh has not given any kind of domestic gas connection to the customer [12]. Every summer Bangladesh face huge load shedding problem. Power Development Board (PDB) sources said while the official power demand was just 5000MW, the unofficial demand was hovering around 6000 MW. Around 1500 MW power could not be generated due to short supply of gas to many power plants. Gas is a major concern also because several new gas-fired power plants with nearly 1000 MW generation capacity are expected to be drafted into service this year.

RECOMMENDATIONS

A. *Import CNG driven buses:*

In the context of Bangladesh, there is need to bring public passenger transport as early as possible on CNG. Financial incentives should be provided to bus operators purchasing new OEM and retrofitted CNG buses in the form of sales tax and excise tax exemption and low-interest loans with the subsidies ideally recovered from enhanced road taxes on private vehicles. While capital costs compared to diesel will go up in case of CNG, operational costs will go down because of the lower fuel cost of CNG as compared to petrol or diesel. Bangladesh Road Transport Corporation (BRTC) has imported dedicated CNG passenger busses to increase the utilization of natural gas. Besides the government initiatives, private entrepreneurs are also importing CNG dedicated passenger busses, as the operating cost is very attractive [13].

B. *Promote alternative fuel*

The government should promote Eco-friendly fuels and improve quality of other fuels with the relevant exhaust treatment devices and engine technology so that different options can compete in the market.

C. *Promote market driven development model for CNG:*

A market driven development model to promote CNG as transportation fuel has been pushed through various policies, such as regulatory mandates, fiscal incentives, capacity and awareness building initiatives including R & D activities. There have been limited market-driven approaches and models for promotion of natural gas as a transportation fuel especially in urban areas of Bangladesh. The extent at which both push and pull strategies have been systematically deployed by the firm both by leveraging its existing brand value as well as simultaneously building it further for consolidation and higher market penetration.

D. *Prepare policy and regulatory framework:*

At a high level, government should conduct integrated resource planning for the energy sector, including environmental and social objectives. Setting a long run and minimum five year moratorium on natural gas exports and using this time to develop a surplus test mechanism and domestic priorities to use of gas can be an effective initiative. An arms-length regulatory agency can be created for natural gas sector. There is a need for the government to launch a vigorous campaign to attract foreign and local investment in the energy sector. The policy should be included new exploration to find out the new gas fields also.

The government may considerably increase funds and provide facilities to Petrobangla and its subsidiary companies, can stand as more viable and effective organizations, and take up the role of gas exploration and production of gas. Government may make the natural gas networks into common carriers with predictable, independently set tariffs, allowing natural gas producers and independent power producers to negotiate directly with customers. RPGCL should provide an adequate and enhanced allocation of natural gas for Bangladesh's transport sector and this allocation should keep pace with the growing demand. Strengthening the legal protection by imposing more laws related to extraction of natural resources, safety and security and ensuring their appropriate enforcement will favor the entire CNG sector.

E. Proper training facilities:

The government should develop institutions to train more people in the energy sector, particularly in the areas of petroleum and natural gas engineering and CNG system.

F. Prepare gas distribution network:

In the locations where a gas distribution network is available, the best approach is to add fast fill CNG units to the existing fuel stations on the main highways and in and around the larger cities. Also

new locations with dedicated fast fill CNG outlets should be foreseen in busy metropolis areas. In the coming months a further delivery capacity from one of the two gas fields in exploration will start to operate. Government is to improve the infrastructure quickly to eliminate the long queues for CNG refueling. Plans for future distribution infrastructure should be set into motion to ensure that it stays ahead of the growing demand and takes into account the turnaround time of vehicles at the dispensing stations.

CONCLUSION

To cope with the power requirement in Bangladesh, the government is focusing their interest about using natural gas in power sector rather than in transport sector. The imprudent use of CNG is causing increase in transport cost and simultaneously effecting on the whole economy of Bangladesh. So the government should take necessary steps to generate power from other source of energy or increase the efficiency of conversion power from gas by some technical method. Renewable energy can be an answer to meet the current power crisis, saving extreme dependency on CNG. Both power and CNG sectors are inevitably important and Government should take positive approaches to incorporate both the sector.

Bangladesh has significant natural gas reserve and out of 1800 mmscfd of being marketed over the country, approximately 72 mmscfd is being used in the CNG sector. The projected demand of gas in CNG sector in the next 5 years will be around 130-150 mmscfd. The new job opportunities creation and the large number of CNG conversion stations should be increased as large number of vehicles are using CNG as a transport fuel. For the using of CNG a positive impact on the country's balance on payment with a substantial reduction of the annual import bills of liquid petroleum as well as reducing the environmental pollution.

REFERENCES

[1] Salma A. Iqbal, M. Iqbal and A.F.M. Salauddin, " Present Scenario of Compressed Natural Gas (CNG) as a Vehicular fuel in Bangladesh", 2nd International Conference on Industrial Engineering and Operations Management (IEOM 2011) January 22-24, 2011, Kuala Lumpur, Malaysia, page 222-227

[2] Babu, A.H. "Use of Cleaner Fuels & Substantial Improvements in Air Quality in Dhaka, Bangladesh" Clean air portal.

[3] Abedin, M.R. "Use of CNG as an Alternative Fuel for Transport-Air Pollution Control Perspective" International Seminar on Air Pollution in Dhaka City, October 30, 2001, France Bangladesh Association of Scholars and Trainees (FBAST). Page-49-54.

[4] Islam M.S.," CNG as an Alternative Fuel-Bangladesh Scenario" Presented in the 2nd International Conference on Chemical Engineering 2008 (ICChE 2008) organized by the Department of Chemical Engineering , BUET, Dhaka, Bangladesh.

[5] Ahmed, M. "Use of Compressed Natural gas for Vehicles in Bangladesh" M.Sc. Thesis PMRE Department, BUET, Dhaka.1999.

[6] Mark Jaccard, Mujibur Rahman Khan, John Richards, **"**Natural Gas Options for Bangladesh" Natural Gas Options for Bangladesh, Centre for Policy Research of IUBAT, Autumn 2000.

[7] Thilotham R. Kolanu and Uma B. Kondury**, "**Market Driven Model for Promotion of CNG as Transportation Fuel in Developing Countries: Learning from a Successful Initiative in India"**,** *Asian Journal Energy Environment* 2007, 08(04), 618-626

[8] Information source – National energy policy of Bangladesh and Hydrocarbon Unit of government of Bangladesh.

[9] Statistics of CNG Filling Station & Conversion Workshop in Bangladesh, from RPGCL website. http://www.rpgcl.org.bd/exp_act.php?ltype=exp_stat The last date of available data is June 28, 2011 has been checked.

[10] Navesey, F., Gas Quality For Natural Gas Vehicle Use, IANGV, Toronto, pp1-7.

[11] Abdul Quader, "Consumption and Options for Development of Natural Gas in Bangladesh," presented at Optimising Use of Bangladesh's Gas Resources, Centre for Policy Dialogue, Dhaka. 1999

[12] Prateep Chouykerd, Navadol Laosiripojana and Chumnong Sorapipatana, "Economic Assessment of Compressed Natural Gas for Diesel Vehicle in Thailand", *Asian Journal Energy Enviornment* 2007, 08(02), 533-539

[13] http://www.brtc.gov.bd/ The last date of available data is June 28, 2011 has been checked.